M E M O R A N D U M

DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF WATER

OFFICE OF WATER RESOURCES MANAGEMENT

SUBJECT: **OWRM Guidance Memorandum No. 93 - 023**
Procedures for Processing VPA Permits for the Food Processing Category

TO: **Regional Directors**

FROM: **Larry G. Lawson, P. E.**
Director, Office of Water Resources Management

DATE: **September 20, 1993**

Copies: **Bob Burnley, Alan Anthony, Dave Paylor, Martin Ferguson, Ron Gregory, Regional Office Water Resource Managers, OWRM Permit Staff**

Attached is the guidance that the Regional Offices should use in the processing of VPA Permits for the Food Processing Category. The guidance consists of two parts:

1. Application Review Guidance Document, and

2. Draft VPA Permit Pages

This guidance now becomes a part of the VPA Permit Manual. As the VPA Permit Manual is updated we will be incorporating the attached guidance into the updated Manual.

If you have any questions regarding the attached please feel free to contact Martin Ferguson.

VPA-FOOD PROCESSING CATEGORY

Application Review

Guidance Document

Word Perfect Documents
VPA1FP.GDE

Introduction

This document was developed to provide permit writers with additional guidance on the review of applications for the items which may need further explanation in addition to the instructions in the application and the guidance in the permit manual. It is **highly** suggested that permit writers hold an initial meeting with the permittee to communicate specific information developed for this category to the permittee. For example, to discuss the parameters required for the **waste characterization**, items to be submitted for verification of lagoon liner integrity or **groundwater protection**, and items needed for each **land application site**. This will aid the permittee in developing the application with the correct information on the first submittal and it will save regional time in attempting to obtain a complete application.

Part C-I

2. Sources of Waste

This section of the application is to identify sources of waste and to describe the facility operations. The required flow diagram/narrative may also serve to meet the application requirements for Item 5 (wastewater treatment facilities). Also, narrative statements are only required if the flow diagram is not self-explanatory.

a. The applicant should provide a concise narrative of the facility operations. This description should give the permit writer a good understanding of what the facility actually does.

b. To compliment the operations narrative and further educate the permit writer, a flow diagram of the facility operations should be submitted. This diagram should be a "working tool" offering as much information as possible in an "easy to read" format. Information on this flow diagram should indicate where industrial wastes and other wastes are produced, the volume of wastes generated and their method of disposal, raw materials that are used and where they enter the process as well as finished products and where they exit the process.

3. Non-Hazardous Declaration

The non-hazardous declaration must be signed in accordance with the Permit Regulation in order for the application to be administratively complete. The certification statement <u>does not</u> need to be supported with analytical results such as TCLP testing. However, the applicant may submit test results with the application if available.

If any of the waste is determined to be hazardous, the application should be returned and the applicant referred to the DEQ Waste Division for further information.

4. Waste Characterization

This document is intended to provide the minimum testing requirements for application sections 4a, b, and c for waste generated by the various food processing industries. It is recommended that the minimum requirements for the waste characterization be communicated to the permittee in the initial meeting to ensure that the application will be correct on the first submittal. Waste characterization recommendations are included for the following food processing categories:

1. Slaughterhouse and Rendering Operations
2. Further Processed Meat Products
3. Dairy Products (Non-animal)
4. Fruit and Vegetable Processing (Flume water only)
5. Fruit and Vegetable Processing (Preserved and canned)
6. Beverage Industry
7. Seafood Industry

The permit writer may determine that additional parameters require analysis based on best professional judgement. It is recommended, however, should you decide to eliminate any of the suggested parameters in this guidance document, that you provide justification for doing so in the fact sheet or statement of basis prepared in the permit development. For new facilities it may be most effective to include a special condition in the permit that requires the owner to provide the actual waste characterization after the facility starts operation.

a. **Slaughter and Rendering Operations**

Slaughterhouse and rendering wastes typically exhibit a high nitrogen content and may have significant amounts of phosphorus. Other potentially land limiting parameters may include salts and sulfates, particularly if the facility engages in hide processing. Heavy metals are usually present in the waste, but experience from the permits already issued has not indicated that these are land limiting factors.

Parameter	Sludge (Infrequent)	Sludge (Frequent) or Wastewater
Flow or Volume	Ft^3/Day	Ft^3/Day or MGD
pH	X	X
% Solids	X	X**
Conductivity		X***
COD		X***
TSS		X****
TOC	X	X
TKN	X	X
Oil and Grease		X
Ammonia Nitrogen		X
Nitrate/Nitrite	X	X
Phosphorus	X	X
Potassium	X	X
Chlorides	*	X
Sodium	*	X
Calcium	*	X
Magnesium	*	X
Sulfate	*	X
Copper		*
Lead		*
Zinc		*
Nickel		*
Cadmium		*

* These pollutants have not typically been land limiting for these wastes. **For the permit issuance**, however, it is recommended that the required testing be conducted to demonstrate that this is the case. **For reissuance** or **NDC conversions**, analysis for these parameter can be waived, with concurrence of the regional regulatory services supervisor, if the prior data indicated that these parameters were not a problem. **For permit modifications involving expansions or significant change of process**, it is recommended that you request a new round of tests to demonstrate that these pollutants continue to remain of no concern. This additional testing may be required through a special condition of the permit.

** Sludge only

*** Wastewater only

**** Wastewater to be spray irrigated only

b. **Further Processed Meat Products**

This category is intended to apply to process waste resulting from the washing, cooling or cooking of consumable meat products. Refer to the slaughter/rendering category for operations engaged in processing of blood, hair, offal, paunch or viscera. These wastes will vary depending on the meat product and how it is processed. Wastes may contain significant amounts of nitrogen in the form of nitrate and lesser amounts of phosphorus.

Parameter	Sludge (Infrequent)	Sludge (Frequent) or Wastewater
Flow or Volume	Ft3/Day	FT^3/Day or MGD
pH	X	X
% Solids	X	X**
TSS		X****
Conductivity		X***
COD		X***
TOC	X	X
TKN	X	X
Oil and Grease		X
Ammonia Nitrogen		X
Nitrate/Nitrite	X	X
Phosphorus	X	X
Potassium		*
Sodium		*
Calcium		*
Magnesium		*
Sulfate		X
Copper		*
Lead		*
Zinc		*
Nickel		*
Cadmium		*

* These pollutants have not typically been land limiting for these wastes. **For the permit issuance**, however, it is recommended that the required testing be conducted to demonstrate that this is the case. **For reissuance** or **NDC conversions**, analysis for these parameter can be waived, with concurrence of the regional regulatory services supervisor, if the prior data indicated that these parameters were not a problem. **For permit modifications involving expansions or significant change of process**, it is recommended that you request a new round of tests to demonstrate that these pollutants continue to remain of no concern. This additional testing may be required through a special condition of the permit.

** Sludge only

*** Wastewater only

**** Wastewater to be spray irrigated only

c. **Dairy Wastes (Non-animal)**

Dairy wastes are typically high in dissolved organic matter and can exert a significant oxygen demand. Sludges may be black, heavy and odorous. Typically pH is low but to a greater degree in cheese plant waste due to the presence of whey. Wastes usually have some macronutrient value and may have significant concentrations of chlorides.

Parameter	Sludge (Infrequent)	Sludge (Frequent) or Wastewater
Flow or Volume	Ft^3/Day	Ft^3/Day or MGD
pH	X	X
% Solids	X	X**
TSS		X****
Conductivity		X***
COD		X***
TOC	X	X
TKN	X	X
Oil and Grease		X
Ammonia Nitrogen		X
Nitrate/Nitrite	X	X
Phosphorus	X	X
Potassium		*
Chlorides		*
Sodium		*
Calcium		*
Magnesium		*
Copper		*
Lead		*
Zinc		*
Nickel		*
Cadmium		*

* These pollutants have not typically been land limiting for these wastes. **For the permit issuance**, however, it is recommended that the required testing be conducted to demonstrate that this is the case. **For reissuance** or **NDC conversions**, analysis for these parameter can be waived with

d. **Fruit and Vegetable Processing - Flume Water only**

These wastes result strictly from fruit and vegetable washing. Refer to the preserved and cannery category for operations where the fruit or vegetable is also peeled, skinned, sliced and/or cooked.

Application review may include a review of pesticides/herbicides used in the specific operation and/or MSDS. Certain pesticide/herbicide formulations may include heavy metals; it is recommended that the waste be tested for any heavy metal identified in your review.

Land limiting parameters are typically hydraulic loading considerations. Macronutrients are rarely present in significant quantities.

Parameter	Wastewater
Flow or Volume	Ft^3\MGD
pH	X
TSS	X***
COD	*
TKN	X
Pesticides	**

* These wastes do not normally exhibit high COD results. It is recommended that this testing be performed for the **permit issuance** only to screen for the presence of additional waste streams.

** At a minimum, it is recommended that you require testing for the pesticide/herbicide most frequently applied and the pesticide/herbicide most toxic. Also require analysis for specific heavy metals included in these formulations.

*** Wastewaters to be spray irrigated only

e. **Fruit and Vegetable Processing - Preserving and Cannery Wastes**

The strength of the waste and waste constituents will vary depending on the fruit/vegetable type and the extent to which it is processed. Land limiting parameters to consider are hydraulics, oxygen demand and sodium adsorption ratio. Salts should be of particular interest when lye peeling is employed. Wastes are not typically rich in macronutrients and heavy metals are not typically land limiting.

Parameter	Sludge (Infrequent)	Sludge (Frequent) or Wastewater
Flow or Volume	Ft^3/Day	Ft^3/Day or MGD
pH	X	X
% Solids	X	X**
TSS		X****
Conductivity		X***
COD		X***
Oil and Grease	(Further processed foods only)	
TOC	X	X
TKN	X	X
Ammonia Nitrogen		*
Nitrate/Nitrite	*	X
Phosphorus		*
Sulfates	*	X
Sodium	*	X
Calcium	*	X
Magnesium	*	X
Sulfur (as sulfate)	*	X
Copper		*
Lead		*
Zinc		*
Nickel		*
Cadmium		*

* These pollutants have not typically been land limiting for these wastes. **For the permit issuance**, however, it is recommended that the required testing be conducted to demonstrate that this is the case. **For reissuance** or **NDC conversions**, analysis for these parameter can be waived, with concurrence of the regional regulatory services supervisor, if the prior data indicated that these parameters were not a problem. **For permit modifications involving expansions or significant change of process**, it is recommended that you request a new round of tests to demonstrate that these pollutants continue to remain of no concern. This additional testing may be required through a special condition of the permit.

** Sludge only
*** Wastewater only
**** Wastewater to be spray irrigated only

f. **Beverage Industry - Alcoholic and Non-alcoholic**

Parameter	Sludge (Infrequent)	Sludge (Frequent) or Wastewater
Flow or Volume	Ft^3/Day	Ft^3/Day or MGD
pH	X	X
% Solids	X	X**
TSS		X****
Conductivity		X***
COD		X***
TOC	X	X
TKN	X	X
Ammonia Nitrogen		*
Nitrate/Nitrite	*	X
Phosphorus	*	X
Total Alkalinity	X	X
Chlorides	*	X
Sodium	*	X
Calcium	*	X
Magnesium	*	X
Sulfur (as sulfate)	*	X
Copper		*
Lead		*
Zinc		*
Nickel		*
Cadmium		*

* These pollutants have not typically been land limiting for these wastes. **For the permit issuance**, however, it is recommended that the required testing be conducted to demonstrate that this is the case. **For reissuance** or **NDC conversions**, analysis for these parameter can be waived, with concurrence of the regional regulatory services supervisor, if the prior data indicated that these parameters were not a problem. **For permit modifications involving expansions or significant change of process**, it is recommended that you request a new round of tests to demonstrate that these pollutants continue to remain of no concern. This additional testing may be required through a special condition of the permit.

** Sludge only
*** Wastewater only
**** Wastewater to be spray irrigated only

g. **Seafood Processing Industry**

The seafood industry is mainly comprised of relatively small operations that are concentrated in areas on the water, or very close to the water. The majority of wastewater flows are seasonal/intermittent in nature and of a relatively low volume. (Note: This industry does not usually generate sludge as the treatment technologies available are not advanced enough to create a sludge.) The strength of the waste and waste characteristics will vary depending on the type of raw product. However, for most cases nitrogen, oil and grease and chlorides(salts) may be land limiting factors.

Parameter	Sludge (Infrequent)	Sludge (Frequent) or Wastewater
Flow or Volume	Ft^3/MGD	Ft^3/MGD
pH	X	X
% Solids	X	X**
COD		X***
TSS		X****
Conductivity		X***
TOC	*	X
TKN	X	X
Ammonia Nitrogen		X
Nitrate/Nitrite	*	X
Phosphorus	*	X
Oil and Grease	*	X
Sodium	*	X
Calcium	*	X
Magnesium	*	X
Chlorides	*	X
Copper		*
Lead		*
Zinc		*
Nickel		*
Cadmium		*

* These pollutants have not typically been land limiting for these wastes. **For the permit issuance**, however, it is recommended that the required testing be conducted to demonstrate that this is the case. **For reissuance** or **NDC conversions**, analysis for these parameter can be waived, with concurrence of the regional regulatory services supervisor, if the prior data indicated that these parameters were not a problem. **For permit modifications involving expansions or significant change of process**, it is recommended that you request a new round of tests to demonstrate that these pollutants continue to remain of no concern. This additional testing may be required through a special condition of the permit.

** Sludge only
*** Wastewater only
**** Wastewater to be spray irrigated only

5. Handling, Treatment and Disposal of Wastes

This section of the application is to provide information to the permit writer on specific handling, treatment and disposal of the wastes (this info may be covered in item 2). This information coupled with conceptual design and construction of facilities and chosen land application sites should assist the permit writer in making a determination on appropriate methods for each. A good reference manual to use for this section is EPA Design Manual document #625/1-80-012 "Onsite Wastewater Treatment and Disposal Systems". Detailed information is provided in a very useable text.

6-9. Storage Facilities, Conceptual Designs, and Groundwater Protection

a. For permit reissuance or no-discharge certificate conversions, it is likely that the treatment/storage facilities have been previously approved by the Department.

(1). **In the case of previously approved facilities**, the applicant should provide a list of the treatment/storage facilities and the dates of DEQ approval if available. If the applicant is unable to supply the approval dates, at a minimum, a statement must be provided that the facilities remain unchanged from those previously reviewed and approved by the Department.

(2). **If the previously approved facilities have been expanded or new facilities have been added since the last approval**, the applicant should submit conceptual engineering plans of the new or expanded facilities for Department approval with the application. Also the facility may need an Local Government Ordinance Form (LGOF) as required by the permit manual.

Unreported expansions or construction of new facilities are violations of the Permit Regulation, the facility's existing VPA permit (for reissuance) and possibly the facility's NDC (for conversions). Depending on the circumstances, you may also want to refer these cases to the Compliance Auditor for enforcement action, especially if the permit or NDC may expire due to delays in receiving the necessary information.

The review of the conceptual designs should be completed during the technical review of the application for new facilities or expansion of existing facilities.

For NDC conversions for existing facilities there will be situations where the owner must upgrade the wastewater handling facilities because: 1. The owner has increased production; 2. The owner has not increased production but our VPA procedures require that additional wastewater handling facilities be installed; 3. Any combination of 1 and 2. The region has the option to require the conceptual design up front as a part of the application, to include a special condition to require the upgrade or to pursue enforcement action based on the facts of the situation. In many cases it

may be more effective to process the permit to include the upgrade schedule with the first requirement of the schedule being submission of the conceptual plans. In these cases, the permit action should not be delayed while the facility undertakes corrective measures to eliminate the deficiencies. The upgrade schedule should not exceed two years and regulation requires that there be no more than nine months between schedule items.

b. For VPA issuances, the applicant should submit conceptual designs for all proposed facilities with the VPA application. We suggest that review and approval of the conceptual designs be conducted in conjunction with the application technical review. The application should not be considered complete until the conceptual design is considered technically adequate.

c. Groundwater

(1). **Existing Facilities:**

In the case of **previously approved facilities** identified in Item 9 of the application, the applicant should submit documentation, when available, that the storage facilities were constructed with an adequate liner. Documentation may include SCS inspection reports, engineer's statement, field permeability data, DEQ approval memoranda, etc.

Facilities which were previously approved without liner requirements or for which documentation of adequate liner construction are not available may, alternatively, submit the results of groundwater monitoring or water balances to demonstrate that the facilities are not impacting groundwater.

Facilities which <u>can not</u> provide (1) adequate documentation that a liner was constructed or **(2) documentation which demonstrates that groundwater is protected** should be permitted with a special, site-specific condition that either addresses collection of groundwater protection data such as groundwater monitoring, requires liner construction or requires a water balance.

(2). **Proposed facilities:** It is recommended that groundwater protection be completely addressed during the permit application technical review. Processing of the VPA draft permit should not begin until the groundwater protection proposal is considered technically adequate along with the application. (This may include a groundwater monitoring plan and/or liner.)

(3) **In the case of discharges to drainfields**, VPA applications for these types of facilities should be returned to the applicant and referred to the EPA as a potential

candidate for the Underground Injection Control Program in accordance with current OWRM guidance.

(4) **In the case of existing pump and haul or recycle systems,** be sure you have data which demonstrate groundwater protection before you decide not to issue a VPA permit for these small facilities. A VPA permit is recommended for cases where adequate groundwater protection cannot be demonstrated through the application process.

10. Flood Potential

The no discharge criteria requires that the storage facilities remain operational and to be designed such that no discharge will occur except in the case of a 25-year 24-hour or greater storm event. Additionally, storage facilities including associated groundwater monitoring wells should be protected from inundation by the 100-year flood wave action.

In reviewing the application, it is recommended that you **ask the applicant to provide documentation to support whether or not the storage facilities are located in the 100-year flood plain.** Sources for flood plain information include planning/zoning offices, soil surveys or FEMA maps.

a. For existing facilities constructed within the 100-year flood plain that are not adequately designed, the facilities should be permitted with a special, site specific condition requiring necessary improvements.

b. For proposed facilities, requirements for the 100-year flood protection should be addressed in the conceptual plan prior to permit issuance.

Part C-II Land Application of Industrial Waste

1. - 2. Land Application Sites

This part of the application form is to provide detailed information on the site(s) to receive land application (Items 1 - 3) and the crops to be grown on each site (Item 4).

a. Site Plans and Maps

The applicant's submittal should consist of a site plan and topographic map which clearly delineates the field boundaries and property lines and identifies any landscape features requiring buffer zones such as drinking water wells, rock outcrops, surface waters, sink holes, steep slopes and occupied dwellings (Refer to Item C.II.1 for complete listing). Depending on the complexity of the site, the topographic map and site plan could possibly be incorporated into one plan.

In reviewing the site plans and maps for completeness, it is recommended that you consider whether the required information is presented with enough detail and accuracy so that you can verify the location of field boundaries, property lines and the various landscape features via physical inspection. We suggest, as a minimum, that each map include a north arrow, a scale, contour interval designation (if applicable) and a legend which defines map symbols.

Site plan/topographic map omissions noted as a result of your site inspection visit should be corrected by the applicant during the technical review process prior to deeming the application complete.

b. Buffer Zone Requirements and Net Acreage

Buffer zone requirements should be determined during the site inspection. Net acreage should be calculated and submitted along with the revised site maps if updates are needed based on the site inspection. Subsequent determinations of land area requirements should be reviewed based on the net acreage for land application.

c. Multiple Sites

For applications proposing multiple, non-contiguous sites, Part C-II should be completed for each site. Preferably, the submittal should be presented as site booklets organized by county and land owner/operator. In addition to the site plan/topographic map, each booklet should contain a general county location map which indicates the location of the land application sites and hauling routes (more important for frequent land application proposals).

3. Agronomic Practices

At a minimum, selected crops, planting and harvesting schedules and anticipated yields based on productivity class should be submitted for each land application site.

Additional information concerning how the application of waste will be scheduled relative to the planting date and growth periods of the crops is also appropriate under this item. In some cases submittal of this information can be delayed if it is later included in an Operations and Maintenance (O&M) Manual. The requirement to submit and maintain an up-to-date O&M Manual should be a Special Condition of every VPA permit.

5. Soil Maps

This part of the application is intended to identify the major soil types present at each land application site in order to (1) confirm soil productivity classes and anticipated crop yield and (2) identify sites which may be unsuitable due to high water tables.

a. **If the county where the land application site is located has been mapped** by the SCS, the applicant may submit SCS soil survey data to fulfill the requirements of this section.

If the applicant decides to use this information, it is recommended that at a minimum the submittal include a copy of the soils map with the land application site boundary super-imposed on this map. The applicant should also list on the application form each major soil type identified by the soil survey along with the corresponding soil characteristics, i.e. texture classification, permeability range, available water capacity, depth to bedrock, depth to seasonal water table and soil productivity classification.

Alternatively, the applicant may submit a corrected SCS map or redefine the soil characteristics for the land application site if it is determined that the soil survey has not properly mapped this particular field location. Preferably, this work should be conducted by a technically qualified person(s) such as a soil scientist.

b. **For unmapped counties**, the applicant will be required to conduct a soil characterization for each land application site to fulfill the application requirements. Again, although not a requirement, it is strongly recommended that a technically qualified person(s) undertake this work. Assistance can also be obtained from the local USDA-SCS office or Virginia Cooperative Extension.

Remember the goal of this section of the application is to develop reliable soil productivity classes which will provide the Department with some estimate of crop yield on which to base land area calculations and to identify sites which may be unsuitable due to high water tables. It is important that this information be provided with all land application permits.

6. Soil Boring

Soil borings are intended to verify the soil survey information provided under Item 5 above.

a. **For previously approved land application sites,** soil boring are not required unless the technical review site inspection indicates that boring are necessary to verify soil characteristics or site conditions.

b. **For proposed facilities and new land application sites,** soil borings are currently required for **frequent land application** and **fixed spray irrigation** sites. However, this requirement may be waived for land application sites in counties which have been mapped by the SCS. The provisions under which soil boring waivers for frequent land application and fixed spray irrigation sites will be considered are as follows:

(1). The applicant has been informed that in the absence of soil boring information, we will be using the most conservative values provided by the SCS survey to develop water table and soil productivity data, and that under these terms marginal fields may be found to be completely unsuitable as land application sites.

(2). The technical review site inspection does not reveal any obvious discrepancies between actual site conditions and the SCS survey.

Soil boring will be required if the applicant is unwilling to accept the conditions of the soil boring waiver approval or the site inspection indicates the need for site specific data.

c. **Infrequent land application sites** do not require soil boring in counties with SCS survey mapping. Also, please note that for those unmapped counties, the soil boring requirements may have been accomplished through the soil characterization required under Item 5 above.

7. Soil Analysis

The applicant may request a soil testing waiver for any listed parameter in the application form. The following **minimum** soil tests are recommended, however, for potential food processing land application sites. For large land application permits, it is recommended that the applicant request the soil testing waivers before collection of samples. Approval of soil testing waivers can be handled regionally for delegated permits.

a. **Infrequent Application of Sludges or Frequent Applications Below Agronomic Rates:**

Soil pH
Cation Exchange Capacity (meq/100g)
Available Phosphorus (mg/kg)
Exchangeable Potassium (mg/kg)

b. **Frequent Applications of Sludges at Agronomic Rates**

All parameters listed.

c. **Wastewaters**

All parameters listed.

The soil samples should be representative of the site and be collected to depths of 0-6 inches. A representative sample typically consists of a composite of 20 randomly collected samples from tract sizes of 5-10 acres. Larger tract sizes can be justified if soils are uniform. Applicants should be referred to the Virginia Agronomy Handbook for further instructions on how to collect representative soil samples. (Procedures for subsequent soil sampling required by the VPA permit should be included in the facility's O&M Manual.)

VPA-FOOD PROCESSING CATEGORY

DRAFT PERMIT PAGES

Word Perfect Documents
FPVPA.IA
FPVPA.IAA
VPAPRMT.IBC

(FREQUENT AT AGRONOMIC RATES)

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from the **(Plant location, storage facility locations, etc.,)**, and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

S L U D G E M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS	
			Frequency	Sample Type

Parameters not included with this page. This is a format example only. A list of possible parameters for this page is provided in the table on the next page.

NL = No Limit, this is a monitoring requirement only

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): **(State monitoring location or refer to attachment).**

4. Refer to Attachment A for field productivity classifications and Attachment B for PAN limitations.

Part I.A.1.a.(1) Sludge Monitoring
Frequent Applications

The following is a list of recommended Part I.A sludge test parameters for facilities classified under one of the six previously identified food processors categories. In addition to the recommended parameters, the permit writer should also evaluate the waste characterization reported with the application to determine if additional monitoring requirements should be included.

Parameters	Slaughter & Rendering Operations	Fruit & Vegetable Processor Canned & Preserve	Beverages Industry	Dairy Products	Further Processed Meats	Seafood Industry
Volume (Gallons) or (gals/acre)	x	x	x	x	x	x
pH (s.u.)	x	x	x	x	x	x
% Solids	x	x	x	x	x	x
TKN (%)	x	x	x	x	x	x
Ammonia Nitrogen (%)	x	x	x	x	x	x
Nitrate (mg/kg)	x	x	x	x	x	x
PAN	x	x	x	x	x	x
Total Phosphorous (%)	x	x	x	x	x	x

Suggested frequency of monitoring is 1/3 months. Analysis should be performed on a composite sample.

(INFREQUENT OR FREQUENT BELOW AGRONOMIC RATES)

Permit No. **VPA00000**
Part I
Page of

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from the **(Plant location, storage facility locations, etc.,)**, and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

S L U D G E M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS	
			Frequency	Sample Type

Parameters not included with this page. This is a format example only. A list of possible parameters for this page is provided in the table on the next page.

NL = No Limit, this is a monitoring requirement only

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): **(State monitoring location or refer to attachment).**

4. Refer to Attachment A for field productivity classifications and Attachment B for PAN limitations.

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from the **(Plant location, storage facility locations, etc.,)** and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

W A S T E W A T E R M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS Frequency**	Sample Type

Parameters not included with this page. This is a format example only. A list of possible parameters for this page is provided in the table on the next page.

NL = No Limit, this is a monitoring requirement only

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): **(State monitoring location or refer to attachment).**

4. Refer to Attachment A for field productivity classifications and Attachment B for PAN limitations.

**** NOTE: Monitoring Frequency is minimum recommended frequency. For year-round operations, monthly or quarterly monitoring may be more appropriate.**

Part I.A.2 **Soils Monitoring**
Infrequent or Frequent below Agronomic Rates

The following is a list of recommended Part I.A soil monitoring parameters for facilities classified under one of the six previously identified food processors categories. In addition to the recommended parameters, the permit writer should also evaluate the waste characterization reported with the application to determine if additional monitoring requirements should be included.

Parameters	Slaughter & Rendering Operations	Fruit & Vegetable Processors	Beverages Industry	Dairy Products	Further Processed Meats	Seafood Industry
pH (s.u.)	x	x	x	x	x	x
Cation Exch. Cap. (meq/100g)	x	x	x	x	x	x

Suggested frequency of monitoring is once per year. Analysis should be performed on a composite sample.

(FREQUENT AT AGRONOMIC RATES)

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from the **(Plant location, storage facility locations, etc.,)**, and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

S O I L S M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS Frequency	Sample Type

Parameters not included with this page. This is a format example only. A list of possible parameters for this page is provided in the table on the next page.

NL = No Limit, this is a monitoring requirement only

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: **(State monitoring location or refer to attachment).**

4. Soil composite samples shall be representative of the soil types delineated by the SCS Soil Survey (or the equivalent). Samples shall be taken at 0 - 6 inches soil depth for each application site.

Part I.A.1.b Wastewater Monitoring

The following is a list of recommended Part I.A wastewater test parameters for facilities classified under one of the six previously identified food processors categories. In addition to the recommended parameters, the permit writer should also evaluate the waste characterization reported with the application to determine if additional monitoring requirements should be included.

Parameters	Slaughter & Rendering Operations	Fruit & Vegetable Processors Flume Water	Fruit & Vegetable Processors Canned & Preserved	Beverages Industry	Dairy Products	Further Processed Meats	Seafood Industry
Flow (MG)	x	x	x	x	x	x	x
Application Rate (Max Hourly) (in/hr) [1]	x	x	x	x	x	x	x
Application Rate (Max Weekly) (in/week) [1]	x	x	x	x	x	x	x
pH (s.u.)	x	x	x	x	x	x	x
TKN (mg/l)	x		x	x	x	x	x
Nitrate (mg/l)	x		x	x	x	x	x
Sulfate as SO4 (mg/l)	x					x	
Sodium (mg/l)			x				x
Oil and Grease (mg/l)							x
PAN	x	x	x	x	x	x	x
Chlorides (mg/l)	x		x	x	x	x	x

1. Maximum hourly application rate of 0.25 inches per hour and a maximum weekly rate of 2.0 inches per week.

Suggested frequency of monitoring is once per year. Analysis should be performed on a composite sample.

Part I.A.2.b.(1) Soils Monitoring
Frequent Applications

The following is a list of recommended Part I.A soil monitoring parameters for facilities classified under one of the six previously identified food processors categories. In addition to the recommended parameters, the permit writer should also evaluate the waste characterization reported with the application to determine if additional monitoring requirements should be included.

Parameters	Slaughter & Rendering Operations	Fruit & Vegetable Processors	Beverages Industry	Dairy Products	Further Processed Meats	Seafood Industry
pH (s.u.)	x	x	x	x	x	x
Cation Exch. Cap. (meq/100g)	x	x	x	x	x	x
Avail. Phosphorous (mg/kg)	x	x	x	x	x	x
Exch. Potassium (mg/100g)	x	x	x	x	x	x
Hydraulic Cond. [1] (in/hr)	x	x	x	x	x	x

1. Fixed wastewater systems only.

Suggested frequency of monitoring is once per year. Analysis should be performed on a composite sample.

(INFREQUENT OR FREQUENT BELOW AGRONOMIC RATES)

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from the **(Plant location, storage facility locations, etc.,)**, and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

S O I L S M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS	
			Frequency	Sample Type

Parameters not included with this page. This is a format example only. A list of possible parameters for this page is provided in the table on the next page.

NL = No Limit, this is a monitoring requirement only

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: **(State monitoring location or refer to attachment).**

4. Soil composite samples shall be representative of the soil types delineated by the SCS Soil Survey (or the equivalent). Samples shall be taken at 0 - 6 inches soil depth for each application site.

Part I.A.2 **Soils Monitoring**
Infrequent or Frequent below Agronomic Rates

The following is a list of recommended Part I.A soil monitoring parameters for facilities classified under one of the six previously identified food processors categories. In addition to the recommended parameters, the permit writer should also evaluate the waste characterization reported with the application to determine if additional monitoring requirements should be included.

Parameters	Slaughter & Rendering Operations	Fruit & Vegetable Processors	Beverages Industry	Dairy Products	Further Processed Meats	Seafood Industry
pH (s.u.)	x	x	x	x	x	x
Cation Exch. Cap. (meq/100g)	x	x	x	x	x	x

Suggested frequency of monitoring is once per year. Analysis should be performed on a composite sample.

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage wastewater/effluent sludges from the **(Plant location, storage facility locations, etc.,)** and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

G R O U N D W A T E R M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS Frequency	Sample Type
Parameters not included with this page. This is a format example only. A list of possible parameters for this page is provided in the table on the next page.				

NL = No Limit, this is a monitoring requirement only.

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: **Groundwater Monitoring Wells Nos. _____ located at the locations noted in the approved groundwater monitoring plan.**

4. The static water level shall be measured prior to bailing well water for sampling. At least 3 well volumes of groundwater shall be withdrawn immediately prior to sampling each monitoring well.

Part I.A.3 Groundwater Monitoring

The following is a list of suggested Part I.A groundwater monitoring parameters for all facilities classified under one of the six previously identified food processors categories.

Static Water Level (elevation)
pH (s.u.)
Total Organic Carbon (mg/l)
Chlorides (mg/l)
Total Dissolved Solids (mg/l)
Nitrate-Nitrogen (mg/l)
Sulfate (mg/l)

Suggested frequency of monitoring is 1/3 months. Analysis should be performed on a grab sample (except for static water level).

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from the **(Plant location, storage facility locations, etc.,)** and the land application sites listed in Attachment A.

2. The pollutants shall be limited and monitored by the permittee as specified below:

S U R F A C E W A T E R M O N I T O R I N G

PARAMETERS	LIMITATIONS	UNITS	MONITORING REQUIREMENTS	
			Frequency	Sample Type
See attached list	NL	See attached list	1/3 Months	Grab

NL = No Limit, this is a monitoring requirement only.

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: **(State monitoring location or refer to attachment).**

Part I.A.4 Surface Water Monitoring

The following is a list of suggested Part I.A surface water monitoring parameters for facilities classified under one of the six previously identified food processors categories.

pH (s.u.)
Chlorides (mg/l)
Dissolved Oxygen (mg/l)
TKN (mg/l)
Nitrate-Nitrogen (mg/l)
Sulfates (mg/l)

Suggested frequency of monitoring is 1/3 months. Analysis should be performed on a grab sample.

The following special conditions are general and apply to **all** food processing category permittees:

B. Other Requirements or Special Conditions

1. There shall be no discharge of pollutants to surface waters from this operation except in the case of a 25 year 24 hour or greater storm event. The operation of the facilities of the owner permitted herein shall not contravene the Water Quality Standards, as adopted and amended by the Board, or any provision of the Water Control Law.

2. **(For Facilities with Material Storage)** Any and all product, materials, industrial wastes, and/or other wastes resulting from the purchase, sale, mining, extraction, transport, preparation, and/or storage of raw or intermediate materials, final product, by-product or wastes, shall be handled, disposed of, and/or stored in such a manner so as not to permit a discharge of such product, materials, industrial wastes, and/or other wastes to State waters, except as expressly authorized.

3. (**For Facilities without an approved O & M Manual**)
The owner shall develop an Operations and Maintenance (O&M) Manual for the treatment works/pollutant management system permitted herein. This manual shall detail practices and procedures, including applicable Best Management Practices, which will be followed to ensure compliance with the requirements of this permit. The manual shall be submitted for staff approval within 90 days of the (**effective/ modification**) date of this permit (and approved prior to start-up of operations*). The owner shall operate the treatment works/pollutant management system in accordance with the approved O & M Manual which becomes an enforceable part of the permit.

* For proposed facilities only

OR

(For Facilities with an approved O & M Manual)
The owner shall maintain an Operations and Maintenance (O&M) Manual for the treatment works/pollutant management system permitted herein. This manual shall reflect the practices and procedures, including applicable Best Management Practices, followed by the permittee to ensure compliance with the requirements of this permit. Any changes in those practices and procedures shall be documented and submitted for staff approval within 90 days of the effective date of the changes. Upon approval of the submitted manual change, the revised manual becomes an enforceable part of the permit.

The following special conditions are specific to **wastewater management** in the food processing category:

B. Other Requirements or Special Conditions (cont).

1. Wastewater shall be applied only at the sites identified in (Part I A. or Attachment A).

2. (**For spray irrigation systems**) Wastewater shall not be applied at the rates that exceed (**0.25 in/hr maximum**), (**1 in/day maximum**), and (**2 in/week, maximum**). (Rates may be increased if justified otherwise.)

3. Operations limitations during periods of inclement weather:

   a. Wastewater shall not be applied when the ground is saturated or during periods of rainfall.
   b. Wastewater shall not be applied to cultivated or bare ground covered with ice or snow.
   c. Wastewater shall not be applied to frozen ground.

4. A summary report of each (**reporting period**) activities shall be submitted to the Department by the 10th of the following month, covering the previous (**reporting period**) activities. Reports shall include:

   a. Analyses of composite samples of Industrial wastewater land applied during the previous (**reporting period**) reported on the monitoring report provided in Attachment ___.
   b. Results of (**soils, groundwater, and surface water**) monitoring in accordance with Part I A. of the permit reported on the monitoring report provided in Attachment ___.
   c. Land Application Site information describing the wastewater applied to each field during the previous (**reporting period**) reported on monitoring report provided in Attachment ___.
   d. A summary of the quantities of wastewater stored in or withdrawn from storage facilities and the remaining storage capacity.
   e. A summary of staff gauge readings demonstrating freeboard maintenance.
   f. A summary of spray head utilization demonstrating compliance with the hydraulic loading schedule of the O & M Manual.

The following special conditions are specific to **wastewater management** in the food processing category:

5. An annual summary report shall be submitted to the Department by February 10th of each year. The report shall include:

   a. The yearly wastewater balance showing such items as inputs/drawdown from storage facilities.
   b. Land application site information describing the wastewater applied to each field during the previous year with the annual and cumulative loading constituents and the remaining site life for each field.
   c. A summary of the agronomic practices which occurred during the preceding growing season including but not limited to the timing and number of crop cuttings, an estimate of total crop yield (bushels/acre or tons/acre) removed from the site, any lime and fertilizer additions made to the site (describe type and quantities), and reseeding.

6. The application of wastewater together with any other source of PAN shall not exceed the agronomic loading rate for the crops grown on each site. The application rates shall be calculated for each field based upon the PAN and productivity class table provided in Attachment B. PAN calculations should be made using the results from at least the last 12 month's wastewater samples. The resulting application rates shall be included in the (**reporting period**) 10th-of-the-month reports sent to the Department.

7. The permittee shall cease production operations resulting in wastewater generation should all holding capacity (excluding minimum freeboard) be used and inclement weather and/or plant growth schedule preclude wastewater land application.

8. Wastewater land application shall be controlled by the plant growth schedules in the facility's O & M Manual.

The following special conditions are specific to **sludge management** in the food processing category:

1. Sludge shall be applied only at the sites identified in (Part I A. or Attachment A).

2. (**For Infrequent Application**) Application of sludge shall be on an infrequent (once per five year or 1/5 yr) basis. None of the sites listed in Attachment A which previously received a complete application of sludge shall be used again until at least five years after the date of the last application. Updated soil sampling test results, in accordance with Part I A., shall be submitted before sludge is reapplied to any field.

3. (**For liquid spreader systems**) At no time shall liquid sludge be surface applied at a hydraulic loading rate greater than 14,000 gal/AC (0.5 inches depth) in a single application procedure.

4. Operations limitations during periods of inclement weather.

   a. Sludge shall not be applied during times when the ground is saturated.
   b. Surface application of sludge shall not be made to cultivated or bare ground covered with ice. However, sludge may be applied to snow covered ground if snow cover does not exceed an average depth of one inch and the snow and sludge are immediately incorporated.
   c. Sludge may be applied to frozen ground only under the following conditions:

   (1) solids content of the sludge is greater than 15%,
   (2) slopes are not greater than 5%,
   (3) a minimum of a 200 foot vegetative (or adequate crop residue) buffer is maintained from all surface water courses,
   (4) only those soils characterized by the USDA as "well drained" are utilized,
   (5) vegetation or crop residue is present and sufficient to prevent surface runoff.

5. The application of sludge together with any other source of PAN shall not exceed the agronomic loading rate for the crops grown on each site. The sludge application rates shall be calculated for each field based upon the PAN and productivity class table provided in Attachment B. PAN calculations should be made using the results from at least the last 12 month's sludge samples. The resulting

The following special conditions are specific to **sludge management** in the food processing category:

application rates shall be included in the (**reporting period**) 10th-of-the-month reports sent to the Department.

6. A summary report of the previous (**reporting period**) activities shall be submitted to the Department by the 10th of the following month, covering the previous (**reporting period**) activities. Reports shall include:

   a. Analyses of composite samples of industrial sludge land applied during the previous (**reporting period**) reported on the monitoring report provided in Attachment ___.

   b. Results of (**soils, groundwater, and surface water**) monitoring in accordance with Part I A of the permit reported on the monitoring report provided in Attachment ___.

   c. Land application site information describing the sludge applied to each field during the previous (**reporting period**) reported on the monitoring report provided in Attachment ___.

   d. A summary of the quantities of sludge stored in or withdrawn from storage facilities and the remaining storage capacity.

7. An annual project summary report shall be prepared and submitted by the 10th of each February detailing:

   a. The yearly water balance showing inputs to and drawdown from the storage facilities. Provide the available capacity remaining in each storage facility.

   b. Land application site information describing the sludge applied to each field during the previous year with the annual loading and cumulative loading of limiting constituents (list constituents), and the remaining site life of each field.

   c. A summary of the agronomic practices which occurred during the preceding growing season including but not limited to the timing and number of crop cuttings, and estimate of total crop yield (tons/acre or bushels/acre) removed from the site, any lime and fertilizer additions made to the site (describe type and quantities), and reseeding.

The following are **site specific** special conditions (Paragraph C) to be used with **sludge/wastewater** operations:

Permit No.
Part I
Page of

1. (Sludge)
Sludge shall not be land applied to soils where the water table is less than 18 inches. For all soils with a seasonal high water table of less than 18 inches, site specific soil borings shall be required prior to any land application of sludge during the months in which the water table is commonly high as defined by the SCS Soil Survey. The soil borings shall be performed no more than 7 days prior to land application site activities and shall be conducted over the entire land application site area(s) restricted by the seasonal high water table. If, based on the soil borings in those areas, the water table is less than 18 inches, no sludge shall be applied; if 18 inches or greater, sludge application may occur at the permitted application rates. The signed soil boring logs shall be submitted with the monthly reports.

The following land application sites require soil borings during the high water table months prior to land application of sludge:

		SITE LISTINGS		High Water
County	Land Owner	Field No.	Net Acres	Table Period

2. (Sludge/wastewater-existing)
   a. Within 60 days of the effective date of this permit the permittee shall submit to the Regional Office for approval a protocol to establish either a water balance or a ground water monitoring program for the earthen lagoon.

   b. If the water balance option is selected, then the following requirements shall apply:

      (1) Within 60 days after approval of the protocol, the permittee, utilizing the approved protocol, shall submit by the 10th of each month valid water balances for the previous month. The staff may terminate this requirement at any time by written notification to the permittee.

The following are **site specific** special conditions (Paragraph C) to be used with **sludge/wastewater** operations:

(2) Should any monthly water balance indicate leakage of the lagoon at a rate in excess of 1×10^{-6} cm/sec, the permittee, upon written notification by the Regional Director, shall within 60 days of such notification submit for approval a plan and schedule for corrective action. If the corrective action plan specifies installation of a liner, the liner must exhibit a coefficient of permeability of no more than 1×10^{-6} cm/sec.

(3) Failure to submit the protocol, the monthly water balances, and/or the corrective plan and schedule as required above, shall be deemed a violation(s) of this permit.

c. If the ground water monitoring program option is selected, then the following requirements shall apply:

(1) Within 60 days of approval of the protocol, the permittee, utilizing the approved protocol, shall submit groundwater monitoring data. Thereafter, the permittee shall submit ground water monitoring data in accordance with the protocol schedule. The staff may terminate this requirement at any time by written notification to the permittee.

(2) Should this ground water monitoring data indicate contamination to groundwater, the permittee, upon written notification by the Regional Director, shall within 60 days of such notification submit for approval a plan and schedule for corrective action. If the corrective action plan specifies installation of a liner, the liner must exhibit a coefficient of permeability of no more than 1×10^{-6} cm/sec.

(3) Failure to submit the protocol or, the ground water monitoring information, or the corrective plan and

The following are **site specific** special conditions (Paragraph C) to be used with **sludge/wastewater** operations:

schedule as required above, shall be deemed a violation(s) of this permit.

3. (Wastewater, required if facilities have design flows of ≥ 0.04 MGD appropriate) A licensed operator class ___ is required at this facility.

4. (Sludge/Wastewater facilities where storage and treatment is provided) A Facilities Closure Plan shall be developed prior to termination of the pollutant management activities covered under this permit. The plan shall incorporate:

   a. The volume, percent solids, nutrient content, and other waste characterization information appropriate to the nature of the waste materials.

   b. A listing of all waste products at the facility along with a description of procedures for removal, land application, or other proper disposal of the wastes.

   c. Closure plans for all waste treatment, storage, and handling facilities.

   The Facilities Closure Plan shall be submitted to the Department review and approval prior to implementation of the plan.

5. (**For facilities that Land Apply**) Buffer zones shall be maintained as follows:

a.	Distance from improved roadways	25 feet
b.	Distance from occupied dwellings	100 feet
c.	Distance from water supply wells or springs	100 feet
d.	Distance from surface water courses (for surface application with no incorporation)	50 feet
	(for subsurface injection or surface application with same day incorporation)	25 feet
e.	Distance from property lines	50 feet
f.	Distance from rock outcropping (with the exception of limestone outcrops)	25 feet
g.	Distance from Limestone outcroppings **	50 feet
h.	**(Use where applicable)** Distance from artificial agricultural drainage ditches whose primary purpose is to lower the seasonal	

The following are **site specific** special conditions (Paragraph C) to be used with **sludge/wastewater** operations:

high water table and where slopes are less than or equal to 2%. 50 feet

i. Waste shall not be applied in such a manner that it would discharge to sinkholes that may exist in the area.

Staff discussion has resulted in the following special condition recommendation which is **both site and category specific:**

Permit No.
Part I
Page of

1. (Fruit Processing-Flume water only)
The permittee shall notify the Regional Office immediately of any change in pesticides usage such that the pesticides identified in the application as "most toxic used" and "most used" change. The Regional Office may require wastewater monitoring for the reported change(s).

No other category specific special conditions were discerned as being necessary as minimum requirements.

NOTE TO PERMIT WRITER: THE FOREGOING SPECIAL CONDITION RECOMMENDATIONS ARE MINIMUM RECOMMENDATIONS FOR THE FOOD PROCESSING CATEGORY. THE PERMIT WRITER IS ENCOURAGED TO DEVELOP AND UTILIZE SITE SPECIFIC SPECIAL CONDITIONS WHICH ARE WARRANTED BY SCREENING DATA AND JUSTIFIED IN A FACT SHEET. CARE SHOULD BE EXERCISED TO NOT REQUIRE ANY EXTRANEOUS OR REDUNDANT INFORMATION WHICH WILL NOT BE USED TO VERIFY SITE MANAGEMENT AND PERMIT COMPLIANCE.

Permit No. VPA00000

Attachment A
Summary of Currently Approved Land Application Sites

County	Operator	Owner	Designation*	Field Net Acres	Productivity Class
Goochland	Howard Smith	Howard Smith	GO 1-1	49.7	1

*The exact location of all sites can be found in the VPA application.

ATTACHMENT B

Estimated Yields And Recommended Plant Available Nitrogen (PAN)
Rates For Various Nonirrigated Crops Used In Sludge Management Systems

Crop	Productivity Class 1		2		3		4	
	Yield	PAN lbs/A	Yield	PAN lbs/A	Yield	PAN lbs/A	Yield	PAN lbs/A
Corn-Grain	160 bu/A	180	140 bu/A	160	110 bu/A	130	80 bu/A	100
Silage	24 T/A		20 T/A		15 T/A		11 T/A	
Grain sorghum	60 cwt/A	150	50 cwt/A	125	35 cwt/A	100	30 cwt/A	75
Wheat	70 bu/A	100	70 bu/A	100	70 bu/A	100	50 bu/A	75
Barley	90 bu/A	100	90 bu/A	100	90 bu/A	100	70 bu/A	80
Rye	50 bu/A	70	50 bu/A	70	50 bu/A	70	40 bu/A	50
Oats	80 bu/A	80	80 bu/A	80	80 bu/A	80	60 bu/A	60
Fescue or Orchardgrass Pasture**	*	150	*	150	*	130	*	110
Bermudagrass Pasture	*	200	*	200	*	200	--	--
Unimproved Pasture**	*	100	*	100	*	80	*	60
Fescue or Orchardgrass Hay**	4 T/A	200	4 T/A	200	3 T/A	150	2.5 T/A	125
Bermudagrass Hay**	6 T/A	350	6 T/A	350	6 T/A	350	--	--
Alfalfa***	5 T/A	300	5 T/A	300	3.5 T/A	210	2.5 T/A	150
Soybeans								
Full Season	55 bu/A	275	45 bu/A	225	35 bu/A	175	25 bu/A	125
Double Crop	40 bu/A	200	35 bu/A	175	25 bu/A	125	20 bu/A	100

* No yield estimates given for pastures, PAN rates are for optimum grass production to support given number of animal units.
** If legumes, such as clover or alfalfa, are present, they may be replaced by grasses at this nitrogen application rate.
*** At high nitrogen rates, the life of the stand may be shortened and encroachment by grasses may occur. Regardless of productivity class, alfalfa is not well suited to wet soils, even with artificial drainage.
-- Indicates this crop not usually grown on soils in this productivity class.